CHAPTER 11

Protecting the Environment

The mission of DPR is to protect human health and the environment by regulating pesticide sales and use and fostering reduced-risk pest management. All DPR programs are oriented to that mission, with requirements for thorough data review of pesticides before sale or use, local enforcement to ensure laws and regulations are being obeyed and ongoing monitoring of people and the environment to detect potential for pesticide problems. This chapter focuses only on programs directed at environmental protection.

The environmental data collected by DPR (directly by staff and by private laboratories under contract) is critical to the Department's continuing evaluation of pesticide use and practices, and helps the Department implement laws and regulations to prevent pesticide pollution. DPR also performs field investigations to develop and evaluate mitigation measures to prevent off-site movement of pesticides to protect the environment. Monitoring data may also be components of human exposure evaluations performed by the Worker Health and Safety and Medical Toxicology Branches. Monitoring data can also assist the Pesticide Enforcement Branch in its investigations.

Environmental Monitoring Branch has the lead role in implementing the Department's environmental protection programs. The Branch's Environmental Hazards Assessment Program (EHAP) designs and conducts studies to provide data that help assess human exposures and ecological impacts of pesticide residues in the environment. Specific examples include monitoring to evaluate the effect of application methods on movement of pesticides, and to characterize off-site movement after application that may contaminate air, or surface or ground water, or crops. EHAP also conducts studies to evaluate measures designed to mitigate the adverse effects of pesticides, such as procedures involving the application of pesticides, and alternative pest management practices.

Monitoring the environment involves taking samples and analyzing them for specific chemical residues. EHAP staff develops sampling methods for pesticide residues and provides funding to the Department of Food and Agriculture Center for Analytical Chemistry for analytical method development. This ensures that the best procedures are available when they are needed.

These projects focus on monitoring under actual field conditions specific to California. Although other State agencies — including Air Resources Board (ARB), State Water Resources Control Board (SWRCB), Regional Water Quality Control Boards (RWQCBs), Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA), Department of Fish and Game, and Department of Health Services (DHS) — may also sample for pesticides in the environment, the purpose of such sampling would be to meet their specific legal mandates or to sample for ingredients or in media not sampled by EHAP. If pesticides are detected by these other agencies, DPR may conduct additional sampling to confirm the detections, characterize the nature and extent of the detections and, if necessary, determine how the off-site movement of pesticides may be mitigated.

Each scientific advance in the development of new pesticide products requires a similar advance or adaptation in the field of analytical chemistry in order that entomologists, plant pathologists and other scientists may correlate the compositions of the preparations used with the effects observed.
– 1946 Department annual report

Air Programs

DPR conducts a number of activities addressing pesticides in air, including development of strategies to reduce pesticidal sources of volatile organic compounds (VOCs) which contribute to the production of smog. In addition, DPR conducts air monitoring and evaluation under its general reevaluation mandate and under the mandates of Assembly Bill 1807, (Chapter 1047, Statutes of 1983, and amended by Chapter 1380,

Statutes of 1984, AB 3219), the Toxic Air Contaminant Act. *(For information on reevaluation and TAC monitoring, see Chapter 4.)*

Pest control work, by reason of its technical nature, must of necessity be fostered and guided to a great extent by public institutions.
– 1921 Department annual report

Pesticide Element of the 1994 Ozone State Implementation Plan

The federal Clean Air Act requires states to meet national standards for airborne pollutants such as ozone. Many regions in California do not meet these standards. If any region does not meet the national standards for ozone, the area is designated as a nonattainment area, and the federal government can impose its own measures for meeting air standards. In response, California in 1994 submitted a State Implementation Plan (SIP) outlining how it would reduce volatile organic compounds (VOCs) from all sources, including pesticides. (VOCs contribute to the formation of ozone in the lower atmosphere; ozone is a component of smog.) The U.S. Environmental Protection Agency approved the SIP in 1996. In California, the ARB coordinated the overall development of the SIP, including consumer uses of pesticides. DPR is responsible for developing and implementing VOC reduction measures for commercially applied agricultural and structural pesticides.

The SIP is designed to reduce agricultural and commercial structural pesticidal sources of VOCs by 20 percent between the 1990 base year and 2005. (The exception is the San Joaquin Valley, where, because it was already close to meeting desired ozone levels, the goal was to reduce pesticidal VOCs by 13 percent by 1999.)

DPR worked with the ARB and U.S. EPA Region 9 to develop a plan based not on arbitrarily categorizing pesticides as VOC emitters but on measured pesticidal VOC emissions. Accurate data on VOC-producing pesticides was critical to the development of practical emission control measures for the State. DPR's approach to managing pesticide VOC emissions includes determining the VOC emission potential of pesticide products; estimating and tracking pesticide VOC emissions, based on use reporting and emission potential data; and reducing emissions, first by voluntary measures and, if they are unsuccessful, by regulatory means.

Product Reevaluation (Data Call-in): The initial step of the plan was to establish a method to accurately determine the VOC content of pesticide products and to calculate pesticidal VOC emissions. The baseline inventory was calculated by summing the estimated 1990 VOC emissions of each agricultural and commercial structural use pesticide. Emissions for each pesticide were calculated by multiplying the VOC emission factor (EF) value for each product by the use of that product in 1990. (The same methodology is used to estimate pesticidal VOC emissions for subsequent years.) In 1994 and 1995, DPR initiated data call-ins asking registrants to determine the VOC EF of their products either by analyzing products using the thermogravimetric analysis (TGA) method or by a default method that assumes all ingredients in the product except water and inorganic chemicals are VOCs.

Tracking Pesticide VOC Emissions: California is fortunate to have a reporting system for pesticide use which, with the VOC emission factor, allows for an accurate determination of pesticidal VOC emissions. To determine the actual VOC contribution of individual agricultural and structural use pesticides, the VOC EF of each formulated product is multiplied by the amount of that product used in a given year. The Pesticide Use Report is used as the reference for the amount of pesticide use.

The VOC EF of each product is estimated by one of the following: (1) measuring VOC emissions using the TGA method, (2) using measured VOC emissions from similar products, (3) assuming that all ingredients in the product except inorganic compounds, including water, are VOCs, or (4) assigning a default EF value. Additional VOC EFs may be used to calculate relative emissions provided adequate data are provided. For example, data documenting that a change in a specific application technique of a specific pesticide from 1990 lowers emissions could be a supplemental VOC emission factor.

In cooperation with DPR, the ARB developed a baseline inventory of estimated 1990 pesticidal VOC emissions based on 1990 pesticide use data. This baseline inventory may be adjusted if empirical data are developed to determine the impact of temperature, treated substrate (foliage, soil, water, etc.), application technique, and other conditions on VOC emissions.

Voluntary Measures: DPR holds periodic workshops to review progress in meeting the reduction goals. The initial part of DPR's program is to reduce pesticide emissions through a variety of voluntary actions.

These measures include:

- Pesticide manufacturers altering formulations to eliminate or reduce VOC-emitting components;
- Registration of new products designed to be used at very low rates;
- Pesticide users switching to low-VOC formulations;
- Increased adoption of integrated pest management practices which typically includes reductions in the amount of pesticides used; and
- Promoting education and information distribution regarding pesticide VOC emissions and their control.

Regulatory Measures: If VOC reduction goals are not met by voluntary actions, DPR will adopt regulatory measures to reduce pesticide emissions. These measures could include seasonal restrictions on use or prohibitions of use of high-VOC emission pesticides for which alternatives exist that would result in lower VOCs and no increased environmental risks.

Protecting Water Quality

DPR has a Ground Water Protection Program and a Surface Water Protection Program. These programs, under the lead of Environmental Monitoring Branch and administered locally by Commissioners, address both agricultural and nonagricultural sources of pesticide residues in water and include pollution prevention and response elements.

The Ground Water Protection Program is based on general authority in the FAC to protect the environment from harmful pesticides, and specific authority in the Pesticide Contamination Prevention Act (PCPA, AB 2021, FAC sections 13142 through 13152) that establishes a process to prevent further pollution of ground water by agricultural pesticides. The Ground Water Protection Program focuses on developing reduced-risk practices for pesticides identified as having moved through soil to ground water, research designed to evaluate pesticide use practices and irrigation methods that reduce movement of pesticides from application sites, outreach through training programs for pesticide users, and implementation of the PCPA. Chemicals found in ground water or soil due to nonagricultural use, such as uses in urban areas, and that have been determined to present a hazard or potential adverse effect, will be considered for review as part of the reevaluation process. *(See Chapter 4 for discussion of Reevaluation Program.)*

The DPR Surface Water Protection Program has preventive and response components that reduce the presence of pesticides in both agricultural and urban surface water. The program's preventive component includes local outreach to promote management practices that reduce pesticide runoff. It also includes DPR's registration process in which potential adverse effects to surface water quality, particularly those in high-risk situations, are evaluated. The response component includes mitigation options to meet water quality goals, recognizing the value of self-regulating efforts to reduce pesticides in surface water as well as regulatory authorities of DPR and the State and Regional Boards.

In California, both DPR and the State and Regional Water Boards have mandates and authorities bearing on pesticides and water quality. DPR is the lead agency for regulating the registration, sales and use of pesticides in California. The SWRCB is the lead agency for coordinating and controlling water quality in California. The SWRCB and the nine Regional Water Quality Control Boards (RWQCBs) also carry out statewide and regional programs, as well as federal programs mandated under the Clean Water Act.

Management Agency Agreement: In 1991, DPR and the SWRCB signed a memorandum of understanding that identified primary areas of responsibility and authority and provided methods to assure ongoing coordination of activities at the State and local

The full potentialities of a new product for pest control or for injury to plants or animals are seldom realized until its effects have been thoroughly investigated over several seasons. Marketing of many new chemicals follows so closely after their discovery that investigation must be made of all pertinent scientific information to determine whether they are of sufficient value for the purpose intended to warrant registration, and to determine what precautionary handling may be necessary to avoid injury. Unless adequate information can be obtained, registration of a new product must be withheld pending development of the necessary data.
– 1947 Department annual report

levels. A more formal, management agency agreement (MAA) was developed and signed by the two agencies in 1997.

The management agency agreement is designed to:

- Ensure that all pesticides registered in California are used in a manner that protects water quality and the beneficial uses of water while providing effective pest management. (The beneficial uses include municipal and domestic drinking water, ground water recharge, freshwater habitat, wildlife habitat, endangered species protection, and fish spawning.)
- Identify the roles of both agencies regarding water quality protection and pesticide regulation.
- Coordinate local and State authorities to solve water quality problems relating to pesticide use by promoting development and use of preventive practices through both voluntary and when necessary, regulatory efforts.
- Promote interagency sharing of information relating to the study of pesticides and regulatory efforts.

The MAA is carried out by the California Pesticide Management Plan for Water Quality, which describes in detail a comprehensive program for protection of surface and ground water quality. The plan encompasses the development and use of preventive activities and practices, ranging from voluntary to regulatory, to protect the beneficial uses of the State's waters from the potentially harmful effects of pesticides. It identifies the roles of the water boards regarding water quality protection and the role of DPR in pesticide regulation, and promotes interagency sharing of information relating to the study of pesticides and regulatory efforts.

Conservation of human well-being is of utmost importance. The commercialization of an insecticide poison often is attempted as soon as the new toxicant has emerged from the laboratory, frequently with little or no pharmacological information. Before there is commercial exploitation and introduction into homes for intimate contact with unsuspecting users, more data as to acute or chronic intoxication should be available. The determination of toxicities of pesticides is imperative.
– 1943 Department annual report

Protecting Ground Water

DPR began addressing pesticide contamination of ground water in the early 1980s, spurred by the discovery of widespread contamination of ground water from the legal application of the fumigant DBCP. Between 1979 and 1983, the pesticides 1,2-D and ethylene dibromide (EDB) were also found in wells in several counties, and aldicarb was reported in ground water in Del Norte County.

In 1983 the first comprehensive report on pesticides in California ground water — the "Ramlit Report" — found that more than 50 pesticides had been found in 23 counties. DBCP alone had been found in more than 2,000 wells.

In 1984, CDFA began developing a long range plan to selectively control the application of ground applied pesticides. The goal was to compile localized data — such as an inventory of results of well sampling for pesticides and the amount of pesticides applied to soil — on factors that influence movement of pesticides to ground water. These data would be provided as successive "layers" of information to County Agricultural Commissioners. CACs could use the information to make local regulatory decisions or to condition CDFA regulatory decisions at the local level.

At the same time, reports of pesticides in ground water also caught the attention of the Legislature. In 1985, the Assembly Office of Research published "The Leaching Fields," which reported that 57 pesticides had been found in ground water, 22 of which were due to agricultural use. The report hypothesized widespread contamination and recommended more sampling be done to determine its extent.

The Pesticide Contamination Prevention Act (AB 2021): "The Leaching Fields" also contained the first draft of AB 2021, the Pesticide Contamination Prevention Act (PCPA), which was modified and adopted in 1985. The purpose of PCPA was to prevent further pollution of ground water aquifers of the State which may be used for drinking water supplies. "Pollution" was defined as the introduction into the ground waters of the State of an active ingredient, other specified product, or degradation product of an active ingredient of [a pesticide] above a level, with an adequate margin of safety, that does not cause adverse health effects. The statute was based on a then-untested scientific assumption that certain physicochemical and environmental fate characteristics of pesticides could be used to predict movement to ground water.

The PCPA requires DPR to do the following:

- Require pesticide registrants to submit environmental fate data for agricultural use pesticides.[5]
- Use that data to identify pesticides with the potential to pollute ground water.
- Conduct well sampling to determine if potential leachers have moved to ground water.
- Establish a database of well sampling results that must be reported to DPR by all local, county, and State agencies monitoring for pesticides in ground water.
- Submit an annual report to the Legislature that summarizes the reported monitoring results, and the actions taken by DPR for nonpoint sources and by the State Water Resources Control Board for point sources to prevent further contamination of ground water.
- Examine the use of pesticides found in ground water due to legal agricultural use (i.e., applications according to the label) to determine if continued use should be allowed.

By the end of 2000, 16 pesticide active ingredients (or their breakdown products) had been found in ground water as a result of routine agricultural use. This included pesticides found before the passage of the PCPA. Formal reviews had been conducted for still-registered pesticides found in ground water as a result of legal agricultural use. *(See separate article in this Chapter for discussion of review process.)* Pesticide contamination resulting from "point" sources of pollution such as mixing and loading sites, or illegal disposal and detections of pesticides that are no longer registered are referred to the SWRCB for further investigation.

Based on the circumstances of each contamination situation, DPR imposed restrictions on the use of the detected pesticides. All were placed on DPR's restricted material list. For five of the pesticides, DPR focused additional restrictions in one-square-mile areas containing wells with detections. These areas are called pesticide management zones (PMZs). PMZs are identified in regulation by their geographic base meridian, township, section, range number and are specific for the pesticide(s) detected in the area. Specific restrictions on use vary with the pesticide, and include statewide use requirements, prohibiting all uses in their respective PMZs or prohibiting only noncrop uses.

While specific chemicals detected within PMZs are regulated, the program does not address potential pesticide movement into ground water outside PMZs. The 1985 law emphasized identification of pesticides with characteristics that made them a potential threat to ground water. During the 1990s, DPR scientists conducted studies and gathered and analyzed a tremendous amount of data to improve understanding of the mechanisms of pesticide movement to ground water and the management practices that will minimize such movement. They found that identifying areas vulnerable to ground water contamination was just as important as identifying potential problem pesticides. DPR data suggested that soil and climatic conditions often play a critical role in ground water contamination. Using this data, DPR scientists constructed a computer model that identifies areas vulnerable to ground water contamination. They also developed mitigation measures tailored to the mechanisms of contamination in these areas.

Building on this technical and scientific analysis (*see article page 82*), DPR plans to implement a new regulatory approach designed to put the ground water program on a more preventive basis. This change would replace the patchwork of PMZs with designations of contiguous vulnerable areas. Management practices designed to prevent contamination and tailored to the specific mechanism of movement would be implemented in these areas. Ground water protection measures would be required not only in areas where pesticides have been detected but also in all areas identified as sensitive to pesticide movement to ground water.

Pesticide Management Plan: U.S. EPA has proposed a program that would require states to develop "pesticide management plans for pesticides and ground water protection." Under that program, use of certain problematic pesticides would be allowed

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> ***"It is the purpose of this law to prevent further pesticide pollution of the ground water aquifers of this state which may be used for drinking water supplies."***
> *– The Pesticide Contamination Act of 1985*

5 California's definition of "agricultural use" is broad, and includes not only pesticide use in production agriculture, but also on turf (e.g., golf courses, cemeteries) and along rights-of-way.

The Pesticide Contamination Prevention Act Review Process

When a pesticide is found in ground water or soil, and after the detection is verified in a second test, a well-defined process established by the Pesticide Contamination Prevention Act (PCPA) is triggered. This process allows for comprehensive review of the finding and is separate from DPR's suspension or cancellation process.

DPR first determines if the source of reported pesticide contamination is the result of routine agricultural use (application to crop, for example). If levels of contamination in public water systems exceed levels considered safe, the Department of Health Services may take immediate corrective action. In addition, DPR may impose use restrictions regardless of the level of contamination. Actions could include revocation of permits to use pesticides, modification of use practices, or suspension of pesticide product registration.

Pesticide contamination resulting from "point" sources of pollution (such as a spill into a well) and detections of unregistered pesticides are referred to the SWRCB for further investigation. If the pesticide contamination is the result of illegal use of the pesticide, the incident is reported to the County Agricultural Commissioner for investigation.

If the chemical is an active ingredient and does not pose an immediate health threat, and its presence in ground water is due to legal agricultural use, its detection triggers a review by a subcommittee of the Department's Pesticide Registration and Evaluation Committee. (If the detected chemical is an inert or breakdown product of a pesticide, the detection is subject to further regulatory action if toxicological data on file reveal possible adverse health effects for the breakdown product.) The three-member subcommittee consists of one representative each from DPR, OEHHA, and SWRCB. The subcommittee is not intended as a policy-making body but rather, like the committee itself, acts in an advisory capacity to DPR's Director.

The subcommittee conducts an extensive review of toxicological and environmental fate data on the detected chemical. Registrants of products containing detected chemicals may request a public hearing before the subcommittee to present evidence to demonstrate that the detected chemical has not polluted and does not threaten to pollute ground water. Public comments are also solicited. If registrants do not request a hearing, the product's registration is cancelled.

The subcommittee makes one of three findings: (1) that a detected chemical has not polluted and/or does not threaten to pollute the ground water of the State; (2) that the agricultural use of the chemical can be modified to prevent further ground water pollution; or (3) that modification or cancellation of the chemical's use will cause severe economic hardship on the State's agricultural industry, that there are no feasible alternative products or practices that would prevent further ground water pollution, and that a level of the detected chemical can be established which does not significantly diminish the margin of safety recognized by the subcommittee to not cause health effects. The subcommittee submits its findings and recommendations to DPR's Director, who either concurs or makes contrary findings.

Modifications in use ordered by DPR may include prohibition of uses in certain areas. Alternatively, use may be allowed with certain restrictions, for example, prohibiting use on certain crops or during certain seasons.

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in a state only if that state has adopted a pesticide management plan that has been submitted to and approved by U.S. EPA. The philosophy behind the plan is that there are too many local situations and variables to address the use of these pesticides on the label to keep them out of ground water. The plan would require states to implement more preventive actions to protect ground water than the program long implemented under the PCPA. For example, under U.S. EPA's draft proposal, states would have to adopt preventive measures that apply even in the absence of pesticide detections. Under DPR's regulatory framework adopted under the PCPA, California adopted mitigation measures only for pesticides actually found in ground water and these measures largely applied only in areas where the pesticides have been found. (The overhaul of the program planned in 2001 would put the ground water program on a more preventive basis.)

Surface Water Programs

Rice Pesticides Monitoring Program: The objective of this program has been to decrease concentrations of selected pesticides in surface water of the rice-growing regions, with emphasis on Sacramento Valley waterways. In 1999, about 550,000 acres of rice were grown in California, primarily in the Sacramento Valley. The primary pesticide application period is from mid-April through July. Water quality problems can arise during and following pesticide applications, and when rice paddy water seeps through rice levees, or is released from fields, and enters agricultural drains flowing into the Sacramento River.

In the early 1980s, the SWRCB documented that large fish kills in Sacramento Valley agricultural drains were caused by the rice herbicide molinate (Ordram). At the same time, the herbicide thiobencarb (Bolero) was found to be the source of taste complaints in the City of Sacramento's drinking water supply. Beginning in 1983, California's pesticide regulatory agency (now DPR, then a CDFA division), the County Agricultural Commissioners, the California Department of Fish and Game (DFG), SWRCB, Central Valley RWQCB, and the rice industry worked together to develop and implement a plan to control discharges of pesticides from rice fields. Agencies agreed that by holding water in the rice fields, the pesticides in the water could degrade sufficiently to reduce toxicity to acceptable levels in receiving waters.

In 1990, the objectives of these control efforts were clarified, following the adoption of amendments to the Central Valley RWQCB's water quality control plan. This plan established performance goals for molinate and thiobencarb, beginning in 1990, and for the insecticides carbofuran, methyl parathion, and malathion, beginning in 1991. (Performance goals are target concentrations developed to protect the beneficial uses of surface water from rice pesticide contamination and provide a level by which compliance with a monitoring program could be measured.)

DPR's Rice Pesticides Monitoring Program annually monitors for rice pesticides in adjacent agricultural drains and the Sacramento River receiving rice field water. Through a combination of mandated restricted materials permits issued by County Agricultural Commissioners, and voluntary management practices implemented by rice growers, this program has been successful in reducing concentrations of targeted pesticides, and pesticide loading in affected waterways receiving rice field water runoff.

DPR's Environmental Monitoring, Enforcement, and Registration branches work together to continually evaluate proposed rice pesticides for possible environmental fate problems. Many issues related to old and new rice pesticides including pesticide drift, phytotoxicity to non-target crops, weed resistance to rice herbicides, aquatic toxicity, sediment accumulation, and drinking water concerns continue. Past, present, and future success of the Rice Pesticides Program depends on maintaining collaborative relationships that have been established over the years within DPR, and with external stakeholders including the State and Regional Water Boards, DFG, the commissioners, pesticide registrants, California rice industry, and rice growers.

Dormant Spray Water Quality Program: Use of organophosphate insecticides on dormant fruit and nut trees is extensive in the Central Valley. Use of these chemicals in winter may reduce the need for pesticides during the growing season, but pesticide

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In addition to cautions specifically required by law, a registrant should warn of any danger involved in the use or misuse of his product. This promotes satisfactory use of his products .... Any precautions with regard to proper storage should be given. No invitation may be made to the purchaser to experiment with the material.
– 1944 Department annual report

Preventing Ground Water Contamination

Scientific data evaluated by DPR during the 1990s gave DPR the basis to put its ground water program on a more preventive basis. The main scientific hurdle was to characterize vulnerable areas. DPR found many pre-emergence, soil-applied herbicides in ground water, with wells frequently containing residues for three different herbicides. Since the use patterns for these herbicides are similar, this suggested that identifying the factors that make an area sensitive to ground water pollution would be as important as identifying which pesticides have the potential to pollute ground water.

Determination of Sensitive Areas

Early attempts by DPR to correlate pesticide detections in ground water with various factors were frustrated by insufficient and inadequate data for analysis. Before the early 1980s, soil studies of pesticide movement typically focused on product efficacy and only analyzed residues from shallow soil depths. This information was only useful to determine whether or not active ingredients remained in the root zone in sufficient concentrations to affect their biological targets, or to determine if they had dissipated in time to prevent injury to later crops. Most soil studies failed to test for soil residues below three feet.

Since 1986, DPR scientists have been collecting and identifying data to better characterize vulnerable areas and other factors that influence pesticide movement to ground water. The evaluation allowed for the development of ground water protection measures based on the best available scientific information.

A variety of data were evaluated, including:

- DPR's well inventory database, with results from sampling of more than 20,000 wells.
- DPR's use reporting database. Beginning in 1990, all agricultural uses of pesticides are reported to DPR, usually by township, range, and section.
- Soils information published by the USDA Natural Resources Protection Service (formerly the Soil Conservation Service).
- California weather and evapotranspiration data collected by the California Irrigation Management Information System (CIMIS) and the U.S. National Oceanic and Atmospheric Administration.

With this and other data, DPR constructed a database of soil types by township, range, and section. The data enabled DPR to develop a method or model to predict where pesticide contamination of ground water is most likely to occur. Using the additional soils and climatic databases, DPR scientists used multivariate statistical techniques to determine if there are relationships between these data and pesticide detections. (Multivariate statistics provide the ability to analyze complex sets of data and look at the pattern of relationships between several variables simultaneously.) That analysis demonstrated that most sections of land with wells containing pesticide residues can be grouped into clusters based on soil type. These clusters appear to be related to the mechanism of pesticide movement to ground water. For example, in the coarse soil cluster (sandy soils), pesticides probably move to ground water via leaching, whereas in hardpan soils, residues move offsite via runoff into drainage or dry wells, abandoned wells, poorly sealed pumping water wells or other more direct pathways to ground water.

This meant that mitigation measures could be potentially customized for each soil cluster. To prevent leaching, good irrigation management is the key because excess irrigation causes leaching. In contrast, leaching is not a problem in hardpan soils, but runoff containing pesticide residues is. Wellhead protection is one of the keys on hardpan soils so that runoff can't easily move to ground water.

Another key is soil incorporation of the pesticide so that residues cannot be carried off by rainfall or irrigation and subsequently move to ground water in adjacent coarse soil areas or via wells or similar direct conduits.

DPR used the cluster analysis to develop a model (called "Calvul" model for "California vulnerable") that identifies areas sensitive to pesticide movement to ground water based on soil type. This new tool has been used to identify many additional areas that have soil types similar to areas where pesticides have been found in ground water.

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runoff from orchards has been detected in the Sacramento and San Joaquin watersheds. Some dormant spray levels in waterways have been high enough to cause toxicity to aquatic organisms. To deal with the problem, DPR established the Dormant Spray Water Quality Program in 1996.

Rather than immediately move to mandatory restrictions, DPR, working in concert with the County Agricultural Commissioners, first asked local resource conservation districts, farmers, and pesticide manufacturers to develop methods to control offsite movement of these chemicals. Risk reduction measures are focused on orchards near rivers and streams, and can include avoiding mixing and loading near streams, reducing rates of application, shutting off spray rigs at the end of rows near streams, and using alternative pesticide products.

DPR is using monitoring and other data to evaluate the success of the voluntary efforts toward achieving water quality compliance. As long as progress continues toward compliance with the water quality objectives established by the RWQCBs, regulations will be unnecessary. However, if aquatic toxicity persists from dormant sprays, DPR will impose regulatory controls to lower dormant spray residues to acceptable levels.

DPR is also working with the Sacramento River Watershed Program, a stakeholder-driven effort to promote stewardship in the watershed and improve aquatic habitat, and to develop a water quality management strategy for diazinon, a key dormant spray. Under contract, DPR is working with stakeholders and the Central Valley RWQCB to help develop water quality targets, identify important sources of diazinon, evaluate available management practices including pest management alternatives, determine how new management practices could improve water quality, and develop a plan for promoting water-enhancing practices.

Establishing a Wide-Ranging Surface Water Program: In the 1999-2000 and 2000-01 State Budgets, the Legislature appropriated significant, ongoing resources to DPR to establish a surface water protection program consistent with the Department's longstanding ground water program. New scientific and technical staff were added, and funds became available to monitor the impact of pesticides on impaired water bodies identified by the SWRCB. Impaired water bodies are those that are degraded by specific pollutants, including pesticides. The U.S. Clean Water Act requires a cleanup strategy for each impaired water body; key to developing a strategy is determining total maximum daily loads (TMDLs) for each pollutant. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards. A TMDL also contains the reductions needed to meet water quality standards and allocates those reductions among the sources in the watersheds.

The goal of DPR's surface water program is to characterize pesticide residues in surface water bodies (including rivers, streams, and agricultural drains), identify the sources of the contamination, determine the mechanisms of off-site movement of pesticides to surface water, and develop site-specific mitigation strategies. This is done primarily through surface water monitoring in consultation with other agencies (including the SWRCB and RWQCBs), and research to characterize the factors that lead to off-site movement and to develop use practices to prevent such movement. Research is facilitated by contracting with the University of California, California State universities and the private sector. DPR also maintains a comprehensive database of surface water monitoring results.

Under the terms of agreements between DPR and the SWRCB, DPR will investigate pesticides of concern and help develop recommended pesticide use practices designed to reduce or eliminate the impact of pesticides on surface water quality. Management practices designed to reduce contamination are implemented initially through voluntary and cooperative efforts. Depending on the source of the residue problems, mitigation may include outreach programs to educate the public on ways to reduce pesticides in urban waters as well as programs targeted at modifying use practices among agricultural pesticide users.

If the revised use practices (which do not have the force of law but are voluntarily adopted by pesticide users) do not adequately mitigate the impacts, then DPR must use

DPR's surface water program was greatly expanded in 2000. Its goal is to characterize pesticide residues in rivers, agricultural drains, and other water bodies, identify where the contamination originated, determine the mechanisms involved, and develop site-specific ways to keep the pesticides out of surface water.

its wide-ranging regulatory authority to impose use restrictions. DPR may modify the use of pesticides by regulation or permit conditions to prevent excessive amounts of residues from reaching surface water and to assure compliance with the RWQCBs' water quality objectives. Evaluating the feasibility of these modifications and conditions and promulgating regulations is the role of Environmental Monitoring and Enforcement Branches. If those restrictions are not adequate, then the SWRCB and the Regional Boards could be required to implement waste discharge requirements for discharge entities (e.g., reclamation districts, farms) which may potentially discharge waters containing pesticide residues.

Future surface water projects expected to be made possible by continuing appropriations include validation of management practices for runoff reduction, demonstration and promotion of management practices, and collaboration with the SWRCB and RWQCBs as they implement their Nonpoint Source Pollution Control Program.

DPR's Endangered Species Project Web site, established in 1996, features an interactive database that allows pesticide users to select where in the state they want to use a pesticide – down to a square-mile grid – and get a detailed, customized report on the endangered species restrictions that apply.

Emergency Projects Monitoring

Aerial treatment with malathion bait is used by CDFA to eradicate Mediterranean and Mexican fruit fly infestations in California. DPR conducts monitoring of these treatments to provide information about the amount of malathion and malaoxon (a breakdown product of malathion) reaching the ground, and the concentrations of these chemicals in air, surface water, and rain runoff. These results are used to ascertain that the public and the environment are being protected and that the correct rate of malathion baits are being applied to assure efficacy in eradicating the fruit flies.

In 1999, DPR's Environmental Monitoring Branch began a program to monitor residues of insecticides used in the State's red imported fire ant (RIFA) treatment project. Red imported fire ant, a pest long established in the southeastern U.S., was discovered in late 1998 in several Southern California counties. To manage infestations, CDFA and county and local agencies apply insecticides to RIFA mounds. The wholesale and production nurseries in the infested areas also treat their nursery stock before plants can be shipped under the federal quarantine requirements. DPR monitors representative samples of air, turf, soil and water with the highest priority to determining insecticide concentrations in surface water from irrigation and storm runoff. DPR selected sampling sites on surface waterways, such as local streams and channels in consultation with the County Agricultural Commissioners, Department of Fish and Game, the RWQCB and other stakeholders. DPR routinely shares information and monitoring results with other government agencies, insecticide users, and other stakeholders. If monitoring should indicate levels of concern, DPR works cooperatively to identify the sources of the problem and to investigate how to best resolve them.

Endangered Species Program

In California, DPR has been studying endangered species protection issues with federal funding since 1988. DPR activities include mapping sites occupied by federally listed species, evaluating pesticide exposure risks to inhabited sites, classifying risk and developing protection strategies to minimize risk as needed.

The risks of pesticide exposure to non-target species in general and endangered species in particular are evaluated from registered use patterns, any history of fish or wildlife impacts attributed to a pesticide, or pesticides of similar toxic potential and a comparison of the biology of the non-target species with the pesticide use pattern. A non-target pesticide exposure hazard may exist when a pesticide demonstrates high toxic potential to species in the same general taxonomic group (e.g. birds, fish, mammals, etc.) and the life cycle or behavior of the species and the formulation, site, crop or vegetation stage, season, time and method of application of a pesticide is likely to result in exposure.

Protection strategies for endangered species rely on the differences between endangered species and the species that are the target of pesticide applications. Differences in the size, activity patterns, food preferences, seasonal presence and behavior can be used to selectively expose pest species to a pesticide while minimizing the risk of exposure to endangered species.

As of early 2001, there were 276 federally listed endangered or threatened species in

California, and 18 additional proposed endangered and proposed threatened species. Of all federally listed species, the nine listed populations of salmon and steelhead occupy the most area, defined as watersheds that cover approximately 40 percent of the State, including several entire coastal counties. All other terrestrial and inland aquatic species cover approximately 20 percent of the State, overlapping to some extent with the salmon and steelhead watersheds. Of the terrestrial species, San Joaquin kit fox has by far the greatest overlap with agricultural areas, accounting for about 10 million acres over 14 counties, mostly in the agriculturally rich southern San Joaquin Valley. Other species that are interspersed with agricultural areas include birds, mammals, reptiles, amphibians, crustaceans, insects, and many plants.

Since endangered species are not economic pests, there is no essential conflict between using pesticides and protecting endangered species, provided that non-target hazards of pesticides are understood and adequate protection strategies are developed and used to avoid non-target exposures.

DPR's endangered species program (part of the Pest Management and Licensing Branch) coordinates endangered species protection strategies with the Department of Fish and Game, the Department of Food and Agriculture, and the County Agricultural Commissioners (in accordance with a State Plan). Alternative protection strategies and the State Plan developed under this project are subject to U.S. EPA authorization and U.S. Fish and Wildlife Service approval.

Mapping Endangered Species Habitat

The distribution of most endangered species has not been officially defined. Surveying for the presence of many species is problematic, expensive and unreliable. The mobility of some species and even the dispersal of seeds confound efforts to define habitat. In most cases, the best estimate of current distribution comes from past sightings and current evaluations of land use in these areas. Changing land uses, including field rotations, land development and natural variables such as food supply, droughts, floods and wildfires cause many species to redistribute faster than surveys can be completed. Surveying for the current distribution of species is therefore reserved for special cases where no other approach is feasible to limit pesticide exposure to non-target species.

It is generally adequate and preferable to rely on ongoing interpretations of the best available information on species distribution rather than investing in new surveys. The best available compilation of sightings for federally listed species (and other species of special status) in California is the Department of Fish and Game's Natural Diversity Database (NDDB). Sites in the NDDB are often defined by a central point and a radius (up to one mile) that define the general area of an occurrence of a species. More precise information is used where available.

As a starting point for protecting endangered species, DPR is converting the NDDB data into a list of sections (a species-section database) where these species may be found. Within these sections, a description of habitat (where practical to define) accompanies protection strategies to limit protection strategies to areas that meet the conditions of habitat for a particular species. The species-section database includes links to the NDDB or other citations that document the sections as probable habitat. A procedure is being developed to update the species-section database as needed to ensure that the database includes sections that are necessary and sufficient for species protection.

DPR's species-section database can be readily mapped to show the overall distribution of one or more species in a county or other area of interest. However, the database may be more useful to pesticide users in the ability to support Web-based queries by section. Such queries can be used to determine:

1. if there are any protected species in any user-selected section(s).
2. a list of active ingredients of pesticides that have use limitations for protection of the species triggered by the user-selected section.
3. the use conditions that apply to user-selected sections and active ingredients.

The results of these queries may be printed by the user to guide the application of selected pesticides in selected sections.

When DDT was first released for civilian usage in 1945, a stampede of applicants descended upon the Department seeking registration for products containing the much-publicized insecticide.... Neither the scope of effectiveness of insecticides containing DDT, nor the dangers involved in their use, have been fully explored and, until the hazards have been adequately established, these products should not be used carelessly or in any manner other than recommended for each type.
– 1946 Department annual report